WEST AFRICAN COCOA RESEARCH INSTITUTE

QUARTERLY PROGRESS REPORT

No. 58

TAFO, GHANA.

PRINTED BY THE HAG PRESS—PRINTERS, TAFO.

22 FEB 1961

WEST AFRICAN COCOA RESEARCH INSTITUTE

TAFO, GHANA

FIFTY-EIGHTH QUARTERLY REPORT

APRIL-JUNE, 1960

Any results recorded in this report should not be accepted as conclusive inasmuch as the report contains interim information only. More complete results are published in W.A.C.R.I. Technical Bulletins and elsewhere.

SENIOR STAFF

Director	J. Lamb (on leave)
Acting Director	J.W. Blencowe
Secretary	H.L. Pugh (transferred to Ibadan 29/4/60)
	A.F. Neale (from 15/4/60)
Accountant	J.N.A. Hyde
Office Assistant/Librarian	D.J. Ellis (Miss) (On leave)
TAFO STATION	
Division of Entomology	E. Dunn (went on leave 18/4/60)
	K.B. Armstrong (on leave)
	M.R. Smith (returned from leave 12/4/60)
Division of Pathology	J.W. Blencowe
	A.L. Wharton (on leave)
	P.D. Turner (on leave)
	A.A.F. Brunt
	A. Attafuah (on scholarship in U.K.)
Division of Botany	D.R. Glendinning (went on leave 6/4/60)
	R.G. Hurd (on leave prior to termination 4/5/60)
	R.G. Lockard
Division of Chemistry	R.H. Kenten
	R.K. Cunningham (on leave prior to termination 22/4/60)
Division of Agronomy	T.H.R. Hall
	R.W. Smith
Statistician	C. de Jonge
Laboratory Technicians:	
(Electronics)	A.J.H. Arnold
(Spectrography)	J.C. Burridge
Plantation Manager	H.W.S. Allison
Maintenance Engineer	G.O. Hayward
Works Superintendent	E.K. Berko
Guide-Demonstrator	F.E. Decker
Medical Officer	P.K.K. Knudsen
IBADAN STATION	
Deputy Director (Nigeria)	T.W. Tinsley
Secretary	H.L. Pugh (from 29/4/60)
Entomologists	R.G. Donald
	P.F. Entwistle
	C.K.H. Martini
Pathologists	J.M. Thresh
	D. Kay
Agronomist	J.F. Longworth
Mycologist	E.C. Hislop
Plantations Officer	W. Rides
WEST AFRICAN FUNGICIDES RESEARCH UNIT	
Chemist	P.O. Park

STAFF MATTERS

In the absence of Mr. J. Lamb on leave, Dr. J.W. Blencowe acted as Director at Tafo throughout the quarter.

Dr. M.R. Smith and Mr. A.J.H. Arnold returned from leave in April.

Mr. A.F. Neale joined the staff at Tafo as Secretary in April, and Mr. H.L. Pugh transferred to Ibadan to take up the new post of Secretary of the Ibadan Station.

Mr. R.K. Cunningham and Dr. R.G. Hurd proceeded on leave prior to termination in April and May respectively.

Messrs. E. Dunn and D.R. Glendinning proceeded on leave in April and Miss D.J. Ellis in May.

Dr. T.W. Tinsley attended the 8th International Cocoa Conference in Trinidad from 15th to 25th June.

VISITORS

Visitors to Tafo included Mr. J. Young of Rowntrees, York, officers of the Cocoa Division, Ministry of Agriculture Ghana, a party of 8 American officials of I.C.A., the Principal Agricultural Officer, Eastern Region of Ghana, an official of the Ministry of Economics, German Federal Republic, Mr. Dood of Cadbury Brothers, Bournville, a representative of the Fiji Trading Company from Tokyo, officials of the German and Japanese Embassies in Ghana, and a delegation of 6 M.Ps. from Surinam.

Visitors to Ibadan included Mr. Barat of the International Phytosanitary Commission, The Permanent Secretary, Nigerian Federal Ministry of Economic Development, and Dr. F.J. Simmonds, Director of the Commonwealth Institute of Biological Control.

SITE FOR NEW HOUSE

A lease of 99 years on a site on Moor Plantation has been agreed with the Western Region Government. Architects have been instructed to call for tenders for the construction of a house similar to the smaller of the two built at Moor Plantation in 1958-59. This has been made necessary by the addition of a Secretary to the Establishment.

GAMBARI EXPERIMENTAL STATION - DEVELOPMENT

Acquisition

The Ministry of Lands and Labour and the Ibadan District Council have agreed that the area of approximately

770 acres selected in the northern portion of the Gambari Forest Reserve shall be acquired by the Western Region Government and leased to W.A.C.R.I. The description of the boundaries prepared by W.A.C.R.I. in collaboration with the Forestry Division of the Ministry of Agriculture and Natural Resources has been checked by the Survey Division and we are informed that the acquisition will be Gazetted in July, 1960.

Water Supply

After consultation with water engineers in Ibadan, a suitable site for the extraction of water from the River Ona has been selected and pumping and filtration equipment have been ordered from the United Kingdom.

Building Sites etc.

Clearing of all except the very largest trees has begun on the sites selected for the construction of labour and Junior Staff Quarters and a tractor road of approximately 1¼ miles has been constructed to this site from the main road.

Electricity Supply

No further information on the probable cost of having electricity laid on to the station by the Electricity Corporation of Nigeria has been received from the Corporation. They have, however, indicated that they may prefer to supply power rather than issue a licence for the Institute to instal its own generating plant.

AGRONOMY DIVISION

OLD STATION FARM

The yield from the twenty-two quarter acre plots, for the quarter is shown in Table A1.

Seed Garden

Advantage of the heavy rain in April was taken to plant the one acre of seed garden in the old station. Establishment was extremely satisfactory, seven replacements having been made in June.

Table A1 : Yield in pods from 22-¼ acre plots - Old Station.

Plots	Harvested	Diseased	Total
Tree recorded (5)	153	8	161
Plot recorded (17)	1,514	87	1,601
Total (22)	1,667	95	1,762

TREE MORTALITY

Table A2: Tree Mortality - Old Station - April - June, 1960

Month 1960	Swollen Shoot			Dead Undiagnosed	Total
	Diseased	Contacts	Seedlings		
April 1960	38	9	20	-	67
May "	40	12	23	-	75
June "	35	18	36	1	90
Total	113	39	79	1	232

SQUARE MILE

Maintenance of Mature Cocoa

Routine harvesting of all plots was continuous. Yields are shown in Table A3. Fertilizer application was carried out at the end of April.

Table A3 : Yields in pods from Experimental Plots.

No.	Experiment	Plot	June Quarter 1960	June Quarter 1959
1	U.A. Spacing and Pruning	B2	23,205	8,331
2	U.A. " Extension	B2(a)	5,942	2,986
3	U.A. Multiplication	B1	21,708	13,903
4	Amelonado Spacing Trial	J1	42,691	10,868
5	Factorial Fertilizer Trial	G5	15,945	7,011
6	2nd Establishment Trial	H1 & L2	12,239	11,226
7	Uniformity Trial	G1	39,598	29,490
8	Amelonado Pruning Trial	P2	1,742	1,240
9	" Source Trial	G4	3,381	1,388
10	Shade and Manurial Trial	K1	23,604	17,820
11	Amazon Tree Forming & Pruning	D7	981	-
12	Pathology Expt. Plot	A4	1,884	4,630
13	" " "	A6	7,060	-
14	" " "	H2	1,795	3,654
15	" " "	H3	3,154	3,170
	Total	-	204,929	115,717

MAINTENANCE OF YOUNG COCOA

Shade Experiment

In the Shade Experiment heavy shade reduction was effected in all plots. The trash from the banana and plantain plots was laid as a mulch along the cocoa rows, thereby reducing weed growth. The volume of trash in the banana plots being greater than that in the plantain plots its effect on weed control was more marked. Growth measurements were made on all plots, while sample weights of weeds were also measured.

VIRUS RESISTANCE TRIAL

Reduction of the tree cassava canopy was effected while weeding was continuous. Double stemmed plants were reduced to one leader.

CLONAL MANAGEMENT STUDIES

On the 10th and 11th of June one and a half acres were planted with Pa35 and Na32 cuttings. One half of the area was planted with the fan branches orientated in one direction, while in the other half, no attention was paid to direction of the fan branches. The object of this trial is to study ways and means of growing and tending clonal cocoa to facilitate access.

BLACK POD RESISTANCE TRIAL

Permanent shade trees were planted in May, and by June 17th half the cocoa experiment was planted. Establishment has been exceptionally good, considering the dry spell which preceded the actual planting. Routine maintenance was maintained throughout the quarter.

CLONAL NURSERY

Seventy-five per cent of the coppiced clones have regenerated. Replacements have been made. There was not sufficient re-growth to provide cuttings.

PROPAGATION OF ROOTED CUTTINGS

A total of 3,623 cuttings of varying clones were set during the quarter, of this amount 1,192 had not been removed from the propagators, while the balance gave 71% successful rooting. The performance of the different clones is shown in Table A4.

Table A4: Table showing percentage rooting.

Clone	No. Set	No. Rooted	Percentage Rooted
ACU 85	135	89	66%
R 15	75	63	84%
S 72:J11:4:49	60	48	80%
S 72:J11:4:47	66	50	76%
P 3/7	66	53	81%
S 84	96	75	78%
X 40	72	56	78%
U 5	72	30*	42%
Pa35	180	156	87%
U5/366	174	56*	32%
A 73	66	54	82%
A 12	66	35	53%
S 21	50	50	100%
Z 47	50	50	100%
E 1/70	30	30	100%
K 5/353	30	28	93%
T 60/887	30	30	100%
T 17/359	30	25	83%
S 36	30	25	83%
E 1 (clone)	30	21	70%
SC 1	30	7*	23%
O 4	30	6	20%
T 79/416	30	15*	50%
TF 2	30	4*	13%
E 9	30	15*	50%
Na33/564	60	9*	30%
Na31/566	31	25	81%
Na34/807	36	34	94%
T 60/885	66	52	79%
T 60/888	66	57	87%
T 76/1224	66	50	76%
T 16/613	66	65	99%
T 72/1767	66	55	84%
T 60/1774	66	65	99%
Na32	150	80	53%
T 79/467	66	64	97%
T 63/967	66	63	96%
T 85/799	66	30*	46%

*Parent material not the most suitable for cuttings.

DISTRIBUTION OF PLANTING MATERIAL

Amazon F3

Division of Agriculture Eastern Region	1,000 pods
Sales to W.A.C.R.I. employees	33,600 "

Amelonado Cocoa

Sent to E.A.A. F.R.O., Kenya	100 seed
Sales to W.A.C.R.I. employees	100 pods

FOREST TREE AND ORNAMENTAL NURSERY

Decorative annuals were raised for the flower beds around the laboratory area. Sour and Sweet orange seedlings for stock were lined out.

METEOROLOGICAL DATA

Details of the rainfall are shown in table A5.

Table A5: Meteorology

Month	1960		Past 22-year means	
	Rainfall (ins)	Wet days	Rainfall (ins)	Wet days
April	10.34	15	6.09	11.2
May	1.92	10	7.65	14.1
June	16.45	20	8.57	18.9
Total	28.71	45	22.31	44.2

PATHOLOGY DIVISION

VIRUS RESEARCH

EFFECT OF VIRUS INFECTION ON GROWTH AND YIELD OF AMELONADO AND AMAZON COCOA

In experiments A4 and H2/3 (Quarterly Report 57) almost all trees graft-infected 15 months ago are now visibly infected. In both experiments the canopies of many of the Amelonado trees infected with severe virus isolates have continued to deteriorate. In experiment H2/3, virus-infection is having the greatest effect on the condition of the unshaded Amelonado cocoa. Experiment H2/3 also includes virus-infected Amazon cocoa which so far is less severely affected.

The joint Division of Agriculture/W.A.C.R.I. experiments

have continued satisfactorily.

Yield records, canopy assessments and girth measurements collected from all field experiments during the past year have been summarised for comparison with similar data to be collected in future years

Mechanical transmission of cocoa swollen shoot and mottle leaf viruses

Attempts have been made to increase the rate of transmission by using various source and test plants and by varying the method of extraction. This work continues. Transmissions of swollen shoot virus from infected Bombax brevicuspe Sprague to cocoa half-beans of up to 4 per cent have been got by the methods outlined in the previous Quarterly Report.

A GALL DISEASE OF COCOA IN GHANA

By inoculating tubes of nutrient broth with small pieces of surface-sterlised gall tissue, it has been shown that the pathogen may be cultured in vitro. Since previous attempts (Quarterly Report 56) to graft-transmit this disease have also failed it is not thought to result from virus-infection. Attempts have therefore been made to isolate a bacterial or fungal pathogen. A number of bacteria have been isolated from gall tissue and also from the infective nutrient broth cultures prepared as stated above, but none have been shown to be pathogenic. By contrast, an apparently pure culture of Calonectria rigidiuscula (Berk. & Br.) Sacc. has been isolated from the mixed nutrient broth cultures and in infectivity tests has produced galls on all cocoa seedlings inoculated as beans. Further work is in progress to determine whether C. rigidiuscula is the gall pathogen or whether some other pathogenic organism has been cultured in close association with the Calonectria.

ENTOMOLOGY DIVISION

ANT/MEALYBUG CONTROL TRIALS: METHODS OF APPLICATION AND FORMULATION

These trials continue.

LEAF-EATING LEPIDOPTERA:

Routine collecting and rearing of lepidopterous larvae found on cocoa continues. A list of those lepidoptera so far identified is due to appear in the 1959/60 annual report.

BIOLOGICAL CONTROL OF LEPIDOPTERA

Samples of Bacillus thuringiensis were obtained from

Czechoslovak Academy of Science. This bacterium is deadly to some caterpillars. Preliminary laboratory tests with Earias biplaga Wlk. did not show promise.

NURSE SHADE V. NO SHADE EXPERIMENT ON ESTABLISHED SEEDLING COCOA

In this experiment, (see Quarterly Report No.56) the nurse shade was thinned in mid-November 1959 and was reduced gradually until its removal was completed in early March 1960, on the appropriate plots. The partly de-shaded plots were mulched with freshly cut Guatemala grass between mid-November 1959 and early January 1960 in order to deter growth of grass and to conserve soil moisture.

Quantitative recording of leaf-eating lepidopterous larvae was commenced in late December 1959. Quantitative recording of tree features such as height, girth, number of flush and hard leaves, and the number of flowers and pods was commenced in January 1960. Recording of damage caused by lepidoptera was commenced at the same time. Records of healthy and damaged terminal buds have been made from May 1960 (earlier records were made but owing to a faulty method of recording these are of no value).

Insecticide applications have not yet been carried out. Practically no capsid damage has occurred.

At present the cocoa in the de-shaded plots is, on average, less healthy than that in the shaded plots although there is considerable variation between individual trees. Many of the unshaded trees have not increased in height since they were de-shaded and their growth appears to have become stationery after the formation of the first jorquette. Many of these trees are suffering from a form of die-back which starts at the apex of the twigs and usually stops when it reaches the jorquette. This die-back is associated with the prior loss of the terminal bud and usually the twig becomes leafless before die-back commences. In those cases where die-back occurs on a twig bearing leaves the latter are always past their prime and about to be shed. Other unshaded trees have exhibited a very vigorous growth and their production of twigs and leaves has been greater than that of the most vigorous shaded trees. On the whole, the form of these vigorous unshaded trees is much more bushy than the form of the trees under shade owing to the abundant dichotomy in their branching system.

The records have not yet been analysed but it is aparent that there are larger number of Earias biplaga Wlk. larvae in the unshaded plots than in the shaded plots. The larvae of this species eat and damage the terminal buds and flush leaves of cocoa and it is considered that repeated Earias attack

on terminal buds and young foliage of unshaded trees is closely associated with die-back. The damage and end result is in fact very reminiscent of that caused by capsid attack.

JOINT WACRI/DIVISION OF AGRICULTURE CAPSID CONTROL TRIALS

A trial has been initiated in the Kwahu District to determine the efficiency of Sevin as a capsicide. Sevin is a carbamate insecticide; if it is found to be efficient it will be a valuable alternative to the chlorinated hydrocarbons in case of capsid resistance to the latter.

JOINT WACRI/DIVISION OF AGRICULTURE INSECTICIDE YIELD: COMPARISON TRIAL

There have been possible indications that different insecticides affect yields to a varying degree; these effects not being directly concerned with their capsicidal properties.

Trials have therefore been laid down to compare yields of cocoa treated with gammalin, aldrin and endrin. One trial has been laid down in Eastern Region and another in Ashanti. Both of these have the same statistical layout which is a 5 x 5 latin square; the treatments being BHC, aldrin, endrin, BHC/ aldrin mixture and control. Each latin square covers 10 acres of Amazon cocoa.

NEMATODE STUDIES

The survey on the incidence of Root knot eelworm, melordogyme sp. on cocoa seedlings on W.A.C.R.I. continues.

CHEMISTRY DIVISION

SOIL FERTILITY

Field Experiments

Detailed statistical analyses of all field experiments were completed during the quarter. The results of the trials will be published in the 1959/60 Annual Report.

The six 2^2 NP: KMg (Ca) Factorial experiments on Farmers cocoa in Ashanti/Brong Ahafo region have been concluded. As a result of the trials to date, it has been decided to increase the range of factorial trials over a wider area of the cocoa growing regions. The design of the above six trials has therefore been changed, the new treatments being in the form of a 2^2 N: P Factorial superimposed on the previous treatments.

It is hoped to be able to obtain answers to the following points from the new design.

1. A study of the nitrogen and phosphate responses, and their interaction.
2. To follow the residual effects on the original treat-

ments under the conditions of the new ones.

There will be eleven replications of the sixteen old/new treatment combinations, over the six sites.

A new 3×3^3 fertilizer and shade factorial trial has been designed for the 32 acres of clear felled forest, planted with Amazon cocoa in June, 1958 (K2,01). The planting of half (i.e. 5 acres) of a 10 acre Hybrid (Amazon x Amelonado) shade and manurial trial took place during the quarter.

POT EXPERIMENTS

The experiment described in the previous report (No.57), in which the effects on seedling growth of water, side protection and overhead shade were studied, was terminated early in April. The beneficial effect of constant watering from beneath, noted in earlier experiments, has been confirmed.

Using the same concrete tank layout, a further set of experiments was started in May to investigate in more detail the relationship between the application of ammonium sulphate, soil pH and manganese uptake.

IRRIGATION

Both irrigation trials continue. Regular watering was given, using the mechanical equipment referred to in Quarterly Report No.57.

LABORATORY STUDIES

SOIL AND PLANT ANALYSIS

A long term programme of analysis of leaf material from the Shade and Manurial Experiment (K.1) was initiated in co-operation with Botany Division who collect the samples from the field. A sample of mature leaves is being taken from the lower canopy at 4 weekly intervals. Each sample is obtained by combining one leaf taken from each of 50 marked trees in each plot. The 36 samples obtained in this manner each month will enable the analytical results to be statistically analysed. It is planned that the frequency of sampling will be reduced after one year.

A method of chemical analysis for phosphorus in plant material has been developed by modifying the procedure of Fogg and Wilkinson (Analyst. 1958. 83, 406). The stability of the molybdenum blue colour which they reported when using ascorbic acid as reducing agent has been fully confirmed.

COCOA PREPARATION AND QUALITY

Studies of large-scale fermentation continue. Laboratory work on small scale fermentation has included studies of the effect

on quality of killing beans rapidly by exposure to termperatures of 60°C before fermentation.

Using a spectrophotometric method attempts are being made to follow the changes in the anthocyanin content of finished cocoa during storage.

PLANTATION MANAGEMENT DIVISION

Pods harvested

Table M1 shows the number of pods harvested during the quarter.

SQUARE MILE:

TABLE M1

Period	Young Planted Cocoa Amelonado	Mature Cocoa	Total Pods Amelonado
April	1,792	1,002	2,794
May	5,959	3,976	9,935
June	17,502	13,510	31,012
Total	25,253	18,488	43,741

OLD STATION:

April	400	272	672
May	2,599	3,307	5,906
June	5,393	17,809	23,202
Total	8,392	21,388	29,780

IBADAN STATION

PATHOLOGY SECTION

VIRUS RESEARCH

Transmission of Nigerian Cocoa Virusus

Attempts to establish three species of migratory soil nematodes on potted cocoa seedlings and some other suspected hosts of cocoa necrosis virus have so far failed. New techniques for establishing nematodes on plants are now being tested.

Extraction of Nigerian Cocoa Viruses

An MSE - "Super-Speed 25" - Centrifuge has been installed at the Substation by Mr. A.J.H. Arnold. This centrifuge is being

used in attempts to concentrate viruses after extraction. Results are not yet available.

Tolerance to Swollen Shoot Disease

Three variety trials have been planted to compare the tolerance of certain types of cocoa to virus infection. The first experiment, planted at Araromi in May 1959, consists of six replications of the following six cocoa types :-

T61/1239	x	T16/1664
T86/956	x	T86/1600
T61/1313	x	T61/1403
T62/977	x	T62/891
F3 Amazon	}	as controls.
Amelonado type	}	

The plots were split for early virus infection to obtain a rapid assessment of tolerance. This trial was planted at a wide spacing under banana shade, and growth was poor. Few symptoms of virus infection have appeared since the plants were inoculated in May, 1960.

The second trial was planted at Alakia in July, 1959, at a close spacing under a temporary shade of palm fronds, and the area has been heavily mulched. There was eleven blocks, though there was incomplete replication of certain types. Growth of the seedlings was excellent, and establishment losses were negligible. The plots were split for virus infection, and since the plants were inoculated in March, 1960, regular observations of symptoms have been made.

Tentative conclusions of characteristic reactions of the various cocoa types to virus infection (Quarterly Report No.54) have been confirmed. The Amelonado control has proved most susceptible, with conspicuous swellings and leaf symptoms typical of infection with the severe Ikire virus. At the acute stage of infection crinkling and discolouration, and abcission of the young flush leaves was common.

The Nanay x Nanay crosses produced relatively mild and often transient leaf symptoms, though a more severe reaction was usually associated with acute crinkling of the young leaves which sometimes abcissed. The Parinari x Parinari cross showed the necrotic symptoms described previously, they were associated with chlorotic flecks along the third and fourth order veins, and were most obvious on hardened leaves. Where much vein necrosis was observed in young leaves these either became discoloured, and abcissed, or the necrosis spread into the main veins until the leaf collapsed. In many cases the necrosis spread to the growing

point, and all the jorquette branches of some seedlings have been killed in this way.

In insectary experiments it was noted that F1 Nanay x Parinari crosses invariably produced the Parinari type leaf symptoms. Two types in this field trial were crosses between F1 Nanay x Parinari hybrids, and these showed segregation of the Parinari and Nanay type reactions. Until all plants have produced symptoms it will not be possible to indicate the ratios involved. Two series II hybrids are represented, and both are crosses between F1 Nanay x Parinari hybrids and Trinitarios. Segregation of the Parinari reaction and Nanay type leaf symptoms was again observed. Similarly segregation of these two reactions was noted in a T79 x T85 cross.

A system of scoring symptoms according to their severity has been adopted in order to assess differences between cocoa types in respect of their reaction to virus. The results of a preliminary score are presented in Table 1. The record was taken in July, four months after inoculation with virus.

TABLE P1:

Scoring of Symptoms of virus infection in Different Cocoa types at Alakia

Variety	Symptom-less Plants	Plants with Chlorosis and Vein Clearing. Score					Plants with Chlorotic Flecks. Score					Total infected Plants.	Total Score	Mean Score	% of infected Plants with symptoms	
		1	2	3	4	5	1	2	3	4	5					
R - Amelonado	2	3	24	21	10	-	-	-	-	-	-	60	154	2.57	97	Amelonado
T - T38 x CF ?	21	8	10	16	6	-	-	-	-	-	-	61	100	1.64	66	Amelonado Trinitari
S - "Departmental" Amazon.	19	6	12	15	8	1	1	2	1	1	-	66	124	1.88	71	F3 Amazon
H - T12/26 x T12/151	4	1	8	7	5	-	-	-	-	-	-	25	54	2.16	84	Series I
K - T79/1137 x T79/1138	6	-	3	2	-	-	2	3	3	1	-	20	33	2.36	70	Series I
J - T60/885 x T60/888	10	6	8	8	5	-	1	5	5	1	1	50	101	2.02	80	Series I
M - T79/416 x E1: J92/70	16	7	5	4	-	-	1	3	4	3	2	45	70	1.56	6[illegible]	Series II
L - P4/9.J114/5 x T63/971	3	1	-	1	-	-	-	-	3	2	-	10	21	2.10	70	Series II
N - T79/501 x T85/799	4	6	4	2	-	-	2	2	2	3	-	25	44	1.76	84	Series II
B - T86/956 x T86/1600	-	-	-	2	-	-	1	-	1	1	-	5	14	2.80	100	Parinari type
G - T81/1880 x T81/1792	4	8	2	1	-	-	-	-	-	-	-	15	15	1.00	73	Nanay type (a)
C - T81/1992 x T81/1880	13	1	-	1	-	-	-	-	-	-	-	15	4	0.27	13	
E - T62/977 x T62/891	8	8	5	4	-	-	-	-	-	-	-	25	30	1.20	68	Nanay type (b)
F - T62/958 x T62/1407	4	7	6	3	-	-	-	-	-	-	-	20	28	1.40	80	
D - T61/1313 x T61/1403	16	22	12	17	-	-	-	-	-	-	-	70	101	1.44	77	Nanay type (c)
A - T61/1239 x T61/1664	2	2	4	9	2	-	-	-	-	-	-	19	45	2.36	89	

Nanay type (a) T81 = Na 32 x Na 31

(b) T62 = Na 33 x Na 34

(c) T61 = Na 32 x Na 33.

Whilst there was considerable variation in time of appearance of symptoms within a type, some differences between types were noted. The Amelonado control and the Parinari x Parinari cross were the most severely affected, though at this early stage there were no clear differences between others. There was however an indication of a general difference in the mean score of Nanay types a, b & c.

The scoring system will be continued, and at a later stage related to the effect of virus on growth. If this is successful the system will be adopted to facilitate a rapid screening of material in the insectary.

The third trial, planted at Alakia in April, 1960, consists of six replications of seven cocoa types including five series II varieties, with a series I variety and an Amelonado control. The plots are split for early virus inoculation. The seedlings were planted at a close spacing under palm-frond shade, and the area was heavily mulched.

The effect of enviroment upon virus-infected cocoa

An experiment was planted at Gambari Experimental Station during the quarter involving a factorial arrangement of shade and mulch. Open pollinated progenies of the eleven approved Amazon type are represented in each plot, and half of each plot, containing half of each variety, will be inoculated with virus.

The experiment was planted on clear felled land at a close spacing. The shade consists of a palm-frond canopy. Virus inoculations will be made when the plants are established.

BLACK POD CONTROL

Laboratory studies

Slide germination tests using zoospores of Phytophthora palmivora have been continued and the toxicity of eleven proprietary copper fungicides examined. It is thought that there is very little difference between the toxicities of the copper oxychloride and cuprous oxide molecules. The effectiveness of proprietary compounds is however positively associated with the state of subdivision of the active materials.

The distribution of fungicide deposits on limited areas of the pod surface is being studied chemically by the cellulose acetate stripping technique. A field experiment has been laid down to examine the breakdown of deposits on pods during weathering and pod expansion.

The artificial rain machine has been calibrated and is in use. Preliminary results suggest that about half of the initial deposits of two well known fungicides is removed by the first

three inches of rain but that the remainder is considerably more rain resistant.

Field studies

Two field trials have been started this quarter. In one experiment Bordeaux mixture made with locally purcahsed lime is compared at two frequencies of application with carbide Bordeaux mixture applied three weekly. In the second field trial six proprietary compounds are examined. These fungicides were selected as a result of laboratory tests and it is hoped that they will exhibit a range of effectiveness comparable with laboratory results.

STUDIES ON "DIE-BACK" OF COCOA

An experiment designed to compare the effects on young Amelonado and Trinitario cocoa trees of infection with C. rigidiuscula in the presence and absence of cocoa swollen shoot virus has been maintained for the past six months. Canopy assessments show no differences between virus free and virus-infected trees but there was considerable reduction in leaf canopy on those trees inoculated with C. rigidiuscula.

Various attempts to extract a toxin from material and media infected with C. rigidiuscula have failed

ENTOMOLOGY SECTION

SHOT HOLE BORER STUDIES

An area of seedling cocoa is being planted for further studies on the effects of cultural conditions on infestation by Xyleborus morstatti Hag. (see Quarterly Progress Report, No. 57)

A search for the wet season host plants, other than coffee, alternative to cocoa has not yet been productive. All galleries suggestive of attack by X. morstatti have been incomplete and no beetles were found.

MINOR PESTS OF COCOA

Tragocephala Studies

During the past three months the emergence of adults of Tragocephala nobilis F. var. gorilla Thoms. has continued. Young larvae, the product of eggs laid by females emerging since the beginning of March, are increasing in numbers whilst larvae resulting from eggs laid last year are decreasing numerically as more beetles reach the adult stage.

Scarabaeidae

A small melolonthid beetle, Auloserica sp? nov. (near

konduensis Moser)(identified by Mr. J.L. Gregory of the Federal Department of Agricultural Research) has been noted attacking the flush leaves of seedlings. Attacked leaves present a typical net-like appearance as the lamina is devoured leaving the veins intact.

During the day the beetles hide at the base of the plants, either under soil litter or beneath pots, and do not become active till twilight, when they commence feeding. They appear to be polyphagous and are attracted by ultra-violet light.

Psychidae

Seven species of psychid moths have been found attacking cocoa in Ibadan Province, but the adults of only four of these have been obtained so far. Most seem to have a wide host plant range and not to be specific to cocoa.

Oikiticoides sierricola White, referred to in the previous Quarterly Progress Report, is probably Psyche vuilleti Obth. of Seitz. However, the former species does attack cocoa and its larval case, though very similar to that of P. vuilleti, can be distinguished by the presence of a felt of hairs or plant fibres distally; these are a remnant of the early instar larval case covering and are replaced in P. vuilleti by a granular coating of leaf particles.

Tachinid parasites have been bred from the larvae of Clania vervina Drc., O. sierricola and P. vuilleti.

SCALE INSECTS

An undetermined species of Asterolecanium has been found infesting twigs of Amazon cocoa at Akure in Ondo Province. It probably caused the associated stem swellings which were similar in appearance to those produced by swollen-shoot virus. Attempts to induce artificial infestations and similar symptoms in cocoa seedlings in an insectary have not yet shown results.

SEKA.